

invention can eliminate wasted time and parts that may be encountered in manufacturing assembly lines. The problems can arise from inconsistent understandings as to the latest status of the program that is to be run for assembling parts. These, in turn, may be due to a lack of proper means for tracking the latest version of the program for controlling the running of the manufacturing line. Even if the method or means used for tracking a single digit version number, such as exemplified by designator "V1", for, say, an electronic board (e.g., circuit board, printed circuit board as they may be referred to later), is satisfactory for tracking one type of program, it may not be adequate for tracking changes to the program. In accordance with an aspect of the present invention, version numbers are designated in such a way that any changes made to the same program are reflected in that version. This is accomplished by providing an additional field, for example for decimal places, in the version number (e.g., V1.00), which can be used to reflect the changes that are made in the sub-parts or sub-objects of the main part of the program, in addition to the changes made to the main object itself. Various aspects of the invention will be described with respect to an illustrative embodiment, in which a printed circuit board with electronic components is represented by an object oriented computer program. The aspects of the invention, however, can also apply to other articles of manufacture as well as to other forms of computer representation that are hierarchical in nature.

[0007] Changes may be made to a main object of a computer program representing an article of manufacture, or to one or more sub-objects

of the program. A version management system according to the present invention may also differentiate among differing sub-objects. The present invention provides a method of reflecting a change in a particular sub-object, for example, an object containing instructions for set-up associated with a product. This is accomplished by identifying each program recipe or instruction set by its unique name so that, as the sub-recipes under the main recipe change, those changes are reflected in a portion of the version designator or other status identifier.

[0008] However, every change that is made during development of a program, or during debugging of the program or of the manufacturing line itself, is preferably not reflected in the version designator, for, otherwise, it would be difficult to manage the myriad changes that could take place. Moreover, it may be unnecessary to track changes that do not have any impact on a respective product until those changes are found to be correct and used on a manufacturing line. Validation and release are also characterized with respect to the type of factory in which the manufacturing line is run.

[0009] Thus, in a one-line factory, the engineer who programs an assembly machine to manufacture a product may also be the person who sets up and runs the line. The engineer/operator therefore is knowledgeable about any changes, and can create, validate and release versions of a program corresponding to those changes as he/she sees fit.

[0010] In the case of a factory with several manufacturing lines, or of a geographically distributed manufacturing operation, or of an enterprise with several factories, the engineer who creates a program representing a product may differ from whoever is running the lines and setting them up. In this setting, a question arises as to who has responsibility for issuing the correct version of the program for running the lines, how is the correct version to be issued, and who has the permission to run the line. The present invention provides a release process to help ensure that only the latest working and valid program is released. Even if a slight change were made to the program, the user (such as a process engineer) would be notified that a modification has been made that needs to be approved. In an embodiment of this aspect of the invention, permission to release a particular version of a program depends upon the category of the line: permission for a line release can be given to all personnel (operators, process engineers, managers); for a factory release, to process engineers; and for an enterprise release, to a specific process engineer in the enterprise headquarters. The process disclosed in the instant invention also clarifies the user accountability depending upon where and how the version is released.

[0011] In a first embodiment of the present invention, a method for managing revisions to versions of a program code for manufacturing systems is disclosed wherein a particular program version is downloaded and run on